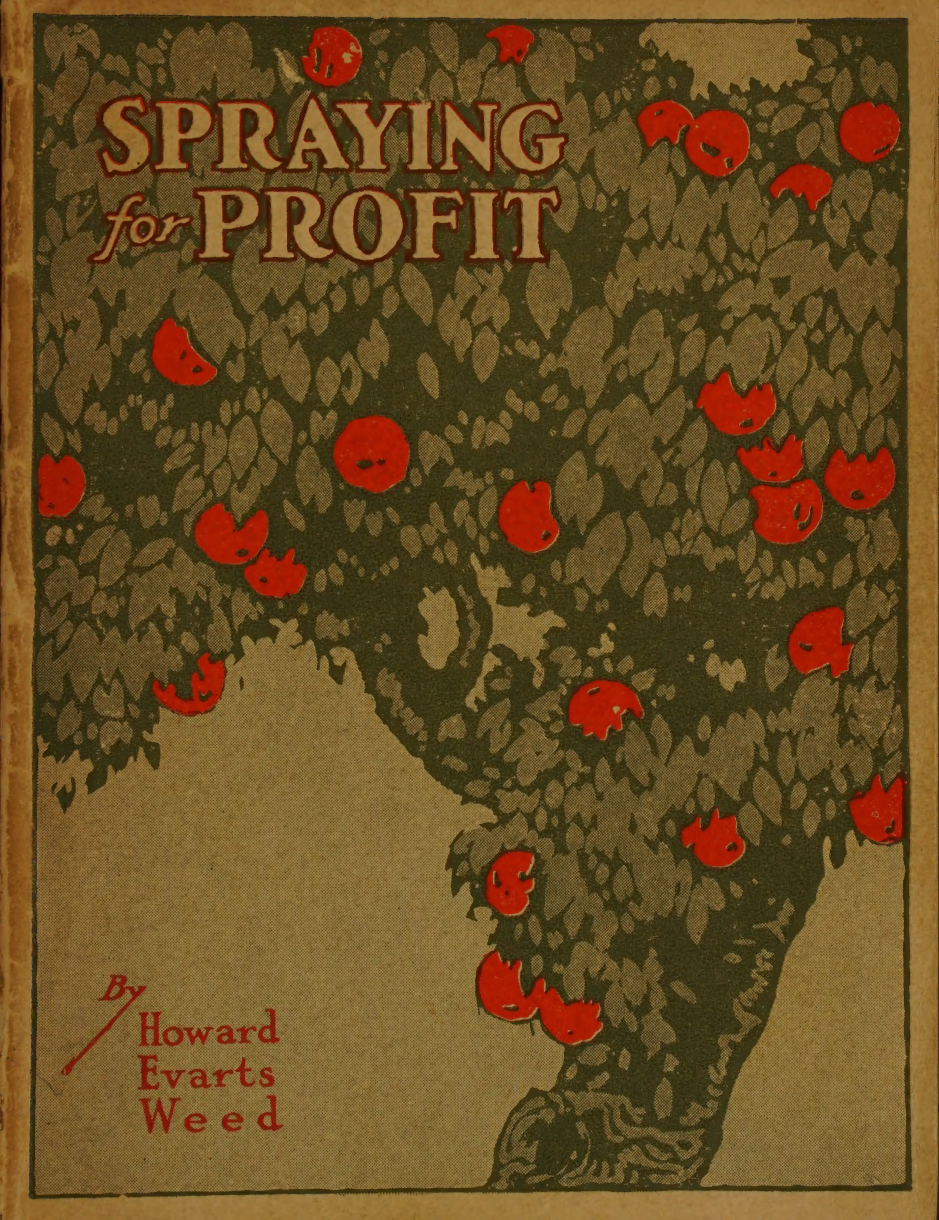




SPRAYING *for* PROFIT

By

Howard
Evarts
Weed

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SPRAYING *for* PROFIT

A Practical Handbook

Describing Best
Methods for Suppress-
ing the More Common
Injurious Insects and
Fungous Diseases



1923

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REVISED AND REWRITTEN

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BY

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FOREWORD TO REVISED EDITION

When this little work was first issued in 1899, the writer's aim was to make it a small, yet complete guide in the spraying of plants—to place before the farmer and fruit grower a practical, condensed hand-book describing the how, when, and why of the application of the more common insecticides and fungicides in daily use for the destruction of injurious insects and prevention of fungous diseases. The fact that twenty-five editions of the work have been issued in twenty-four years—over 300,000 copies—speaks for itself. But during this time new methods of combating the ravages of injurious insects and the control of fungous diseases have come into use, and progress has also been made in improvements to spraying apparatus. These improvements have necessitated changes in the text from time to time. The work was entirely rewritten in 1910 and is now once more rewritten in order that the booklet may still be in the future what it has been in the past—recognized as the *one* guide in the spraying of plants.

While more subject matter has been introduced in the present work, the form is still convenient to the coat pocket. General principles to be used in all spraying operations, together with concise information as to the application of spraying to particular plants, has been the aim. We place a large sized volume aside, expecting to read it tomorrow, only to find that on the morrow we have even less time for reading than today. Growers of special crops will need to study the many excellent bulletins issued

by the Department of Agriculture and the State Agricultural Experiment Stations, for many details in the spraying of these crops.

While spraying is today a recognized part of farm practice, the author is more than ever impressed by the lack of definite information as to the underlying facts or reasons for spraying possessed by the average user of spraying machines. The best results can only be expected by those who understand the reasons for spraying with a given insecticide for a given insect at a stated time. Thus it is that a careful study of each chapter is needed to give one a thorough knowledge of the science and art of spraying. If the first three chapters are taken up as a study, page by page, it will be found that the remaining chapters giving a summary of spraying particular plants and domestic animals can be more readily understood. In fact, the last two chapters should only be consulted after a thorough understanding of the preceding chapters.

While the work is the result of a quarter century's experience in the subject presented, its originality lies in its simplicity. Modern methods in the control of injurious insects and fungus diseases have been brought about by the practical application of scientific facts, in a large measure ascertained by the earnest investigators of the Agricultural Experiment Stations. The author is much gratified at the continued success of the little work. Probably no booklet on a horticultural subject has ever had a larger sale or been more favorably received.

H. E. W.

Portland, Oregon, Nov. 1, 1922.

INTRODUCTION

Estimates as to the annual loss to agriculture caused by injurious insects and fungous diseases show that the yield of all crops is lessened by them fully twenty-five per cent. This means an annual loss of more than *five hundred millions of dollars* in the United States. The annual loss from potato diseases alone is estimated at thirty-six millions. By proper spraying fully seventy-five per cent of this great loss can be prevented. This statement needs no proof, as all practical fruit growers have demonstrated time and again.

Spraying was first practiced about 1878 by the application of Paris green to potatoes for the destruction of the potato beetles. Soon thereafter it was found that for some reason the Paris green spray was also useful in preventing apples from becoming wormy, and then the entomologists gave us the life history of the apple worm which explained the how and why. It is often important that we know the life history or transformation through which an insect passes in order that we may understand the reason for spraying at some particular time. Thus in the case of the apple worm, after we know that the tiny eggs are laid in the blossom end of the young apple, we see the importance of placing a small amount of poison upon each forming apple in order to kill the young worms as they eat through the skin into the fruit.

It was not until after the establishment of the various state Agricultural Experiment Stations in 1887 that spraying came into general practice as a recognized necessity. The many experiments conducted at the Stations showed that spraying was of practically universal application for the destruction of injurious insects and the prevention of

fungous diseases. Spraying is now recognized as *the* practical method of saving crops and a spray pump of some sort is as necessary as a plow. "The man with the hoe" is closely followed by the man with the hose—and the nozzle.

But while *all* admit—for seeing is believing—the great loss caused by injurious insects and fungous diseases, only a *few* realize as yet that this loss is really a benefit to every progressive farmer. For as the loss can be prevented by intelligent effort, it is only the shiftless—the "Peter Tumbledowns"—who do not put spraying into practice. This gives the active, progressive, *thinking* farmer an immense advantage. The market demand for inferior fruit does not pay for its harvest, for it stands little chance for sale alongside the choice fruit. Select fruit must of necessity be sprayed fruit. While spraying means work, it more than pays for itself in the increased market price obtained.



Fig. 1
The San Jose Scale

As an example of the evolution which injurious insects and fungous diseases have brought about in farm practice, take the example of peach growing in Georgia. In former years every Georgia farmer raised peaches in plenty. Some years ago, owing to a steadily increasing demand for Georgia peaches, large additional tracts of orchards were set out. But at a time when the markets would have otherwise been glutted, the San José scale made its appearance in the orchards. This scale (shown in Fig. 1) caused the death of thousands of

trees. The average Georgia farmer became discouraged and gave up peach growing entirely. Others were not willing to let a tiny insect smaller than a pin head drive them out of peach growing, so they increased their orchards, studied the science of spraying and purchased materials and pumps. Today Georgia peach growing is in the hands of specialists whose success lies in the fact that they have become spraying experts.

However, the spraying must be done intelligently or the labor is wasted. Complaints such as the following are common: "I noticed worms on my currant bushes, so sprayed them. But it did not seem to do much good." Upon further inquiry it is usually discovered that the spraying was done after the worms had stripped the bushes of their leaves. When failure occurs it may usually be attributed to the lateness of the application. *Spray in time.* Study the subject thoroughly. Spraying is not a cure-all. It will not bring back to life a dead plant, nor restore the leaves of a tree after they have been eaten off by some caterpillar. The best results are not obtained the first year, especially when spraying for the fungous diseases. *Spraying is plant insurance.* Success lies in giving attention to details.



Plate II
The Apple Scab

CHAPTER I

Some General Principles

Fungous Diseases—Most diseases of plants are caused by low forms of vegetable life known as fungi which live upon and within the tissues of the higher plants. They are thus parasites which obtain their nourishment by the breaking down of the cells of the plants on which they exist. The main difference, other than size, between the fungi and the higher plants is the lack of the green coloring matter so abundant in the higher order of vegetation. The methods of development in the fungi are very similar to that of higher plants, but their microscopic size renders their study more difficult. The parasitic fungi spend the winter mostly within the living and dead vegetable tissues and during the first warm days of spring send out small spores which correspond to the seeds of the higher plants. These spores are disseminated by the wind and otherwise from plant to plant. With favorable conditions as to moisture and warmth, the spores send out small branches which penetrate into the living tissues of the host plant upon which they have found lodgment. Here new branches are formed in immense numbers, which soon sap the vitality of the host plant and cause it to become diseased. New spores are developed on the exterior of the host plant from time to time, but more especially in damp warm weather, and thus a fungous disease may become widely disseminated in a very short time.

By the application of a fungicide to a plant we destroy the spores which have found lodgment upon it and thus prevent the development of additional spores which would cause its disease. Just as long as the tissues of plants are

covered with a thin even coating of a fungicide, no fungi can develop upon them. Thus if a fungicide is applied at regular intervals of about two weeks during the spring and early summer, a plant disease may be held entirely in check.

Thus a fungicide is a *preventive*, and its application should begin long before the disease has advanced far enough to manifest itself to any extent. We should profit by the experience of former years and when our grape vines, for example, are affected with rot this year we should begin the spraying with a fungicide next year long before the time of the manifestation of the disease. It is a well-known fact also that some fungicides—Bordeaux mixture, for example—have a beneficial effect upon growing plants other than their action as a preventive of plant disease. For this reason many nurserymen and others make a regular practice of the application of Bordeaux mixture simply to promote a healthful growth. Its application to some plants is thus good *plant insurance*. Applied to Irish potatoes, it causes the vines to remain green much longer than would otherwise be the case, and this in turn causes the formation of larger tubers. The result of twenty years experimentation in the spraying of potatoes with Bordeaux mixture, by the Vermont Experiment Station as recently published, gives the average yield of the unsprayed plants as 163 bushels per acre, against an average of 268 bushels per acre for the sprayed plants. This makes a difference of 64 per cent. in favor of spraying. Bordeaux mixture will thus increase the yield of potatoes more than enough to pay for its application, even though potato diseases may not be present.

Bacterial Diseases—Unfortunately not all diseases in plants are caused by the fungi. A few are caused by other low forms of vegetable life known as the *bacteria*. These are the “germs” which also cause so many diseases in man and the domestic animals. It will suit our purpose, in this connection, to explain the difference between the fungi and the bacteria by saying that the fungi develop their spores on the *exterior* of the host plant, while the bacteria develop and multiply entirely *within* the plant. The application of any substance, even a fungicide, upon a plant practically does not affect the growth of the bacteria within that plant. Thus the *purely bacterial diseases* cannot be remedied with any form of spraying. About all that can be done, with our present knowledge of the subject, is to practice rotation of crops, select resistant varieties and give proper cultivation. The above explanation is made in this connection in order that it may be understood why spraying is *not a specific in all cases* of plant disease. Perhaps the best known bacterial disease is the twig blight of the apple and pear, known also as the “fire blight” of the pear.

The Leaf-eating Insects—There is a marked distinction in the manner in which insects take their food. Some *eat the leaves* while others *suck the plant juices*. Without knowing to which of these two general classes a particular insect belongs, one is unable to intelligently apply a remedy. Insects which *eat the leaves* have their mouth parts formed for biting off bits of vegetable matter and in this way eat their food in much the same manner as do the higher animals. The insects which suck the plant juices, on the

other hand, have their mouth parts formed into a beak which is inserted into the plant tissues. Thus a large number of the sucking insects on a plant will soon extract so much of its vitality as to cause it to wither and die.

Some of the best known of the eating insects are the Irish potato beetle, cut-worms and the various caterpillars. While these insects can be destroyed by either an external irritant insecticide or a stomach poison insecticide, it is best to apply the last named. These are the various poisons which kill by being eaten by the insects when taken into the alimentary canal or stomach along with particles of food. We thus apply this class of insecticides to the plants, making no effort to apply it directly to the insects. Applied to the plants upon which the insects feed, small particles of the insecticide will be taken into the system and will soon kill the insects by its action as a poison.

Cut-worms—These are the larval form of many species of moths. They attack a great variety of plants and are always more numerous upon land which has been in sod for a year or more. To destroy cut-worms the poisoned bait method is very effective. This may be made by adding one pound of arsenate of lead to thirty pounds of cottonseed meal or bran, mixed dry. Then moisten with water until thoroughly dampened and add a quart of syrup or other sweetening. Now chop two lemons or oranges up fine and add them to the mixture, the odor of the citrus fruit being a great attraction. Cottonseed meal is much the best carried for this mixture, but bran may be used if the meal cannot be readily obtained. Place small quantities of this poisoned bait in various portions of the field where the cut-worms are at work, being careful to place it upon the *ridges* and not in the hollows. It should not be placed where it will be accessible to poultry.

Such poisoned bait is also very useful for the destruction of grasshoppers, which at times do great damage to field crops.

Scale Insects—These are small sucking insects which in former years were introduced into the orchards through the nurseries. Now, however, owing to the various state laws requiring an inspection of all nursery stock by competent entomologists, this source of infection is reduced to the minimum. Unfortunately nursery inspection has only been practiced for a few years past and the various scale insects have become widely disseminated. Owing to the small size of the scale insects their presence is not generally known until the injury caused by their work becomes apparent. A main branch of a fruit tree dies back and upon examination is found to be covered with an incrustation of some sort showing many dark specks. We then find that the tree is infested with some scale in-

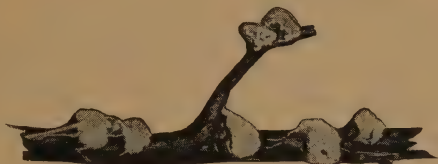


Fig. 2

The Cottony Maple Scale

sect, the most injurious of which is the San José scale shown in Fig. 1. While most scale insects are very small and only appear as minute specks, others are a quarter of an inch or more in diameter. An example of such is shown in Fig. 2, the Cottony Maple Scale, so common in some years upon the soft maples.

All fruit and shade trees, as well as ornamental shrubs, should be examined at least once a year, preferably in win-



Fig. 3
Oyster-shell Scale

For all scale insects we should spray with a *contact* insecticide. Whether this should be applied in summer or winter will depend upon the life history of the scale, or at least in what condition of life the winter is passed. Thus all scales related to the San José, placed by entomologists in the genus *Aspidiotus*, spend the winter as young or mature individuals, the cold weather only retarding their growth. Such scales are best destroyed by a winter treatment. Two quite common scale insects are the Oyster-shell scale, Fig. 3, and the Scurfy Scale, Fig. 4.

ter, to ascertain if scale insects are present. If only a few trees or plants are found infested, it is perhaps best to destroy them by burning, hoping to eradicate the scale completely. But if the scales are present on any large number of plants, spraying should be promptly and thoroughly done. It is important, however, that we know the particular scale with which we have to deal and if it is not recognized readily, it will be best to send specimens to the State Agricultural Experiment Station for determination.



Fig. 4
Scurfy Scale

These spend the winter in the egg state and can be controlled with the dormant sprays.

Plant Lice or Aphids—

These are the soft bodied insects common upon a great variety of plants throughout the summer. They may be green in color, as is the case with the lice on the underside of rose leaves and



Fig. 5
Plant Lice

on the flowers of the common snowball in June. Some are red, a common form occurring on Rudbeckia or the Golden Glow in August. Still others are black, such as the common Cherry Aphis. Green, however, is the more prevalent color. Plant lice may or may not have wings, both forms being shown in Fig. 5. The most common form during the summer months are the wingless females which produce living young. Winged males appear in autumn. *Some species lay eggs in autumn which are not hatched until the following spring, while the females of other species are protected in winter by ants, who carry them to the interior of their nests and in the spring place them upon the proper food plant. The ants feed upon the "honey dew" which is no more or less than the sap of plants pumped out by either scale insects or plant lice. Whenever large numbers of ants are seen upon a plant it*

is a good indication that either scale insects or plant lice are present.

The general remedy for the plant lice is the application of a contact insecticide such as nicotine sulphate.

Ants—On account of the relation of ants and aphids, it is quite important that the nests of all ants be broken up, if the aphids are to be kept in check from year to year. The ants may be destroyed by making holes one or two feet deep into the nests with a pointed stick or crow bar, pouring in several ounces of bisulfide of carbon. This is a volatile liquid, the fumes of which are heavier than air. In case a nest is especially hard to destroy, remove the top dirt from it, treat the remainder with a nicotine solution or carbolineum, and fill in with fresh dirt, well treated.

Lice on Domestic Animals—These exist in great variety, the different species of animals having a different kind of lice attacking them. Animals infested with lice should be sprayed with one of the many special preparations for such purposes. Brush well into the hair. For mites in poultry houses spray the houses thoroughly with 10 per cent kerosene or one of the special insecticides prepared for such purpose.

SOME THINGS TO REMEMBER

Spray intelligently, having a definite aim in view and knowing the results that are expected to follow.

Spray thoroughly or not at all. This can be accomplished by the application of a small amount of the spray liquid on *every part of the plant*, top, middle, and bottom.

An excess of spray at any particular point is both wasteful of material and may cause injury to the foliage.

Never spray fruit trees when in bloom. The spraying is apt to wash off the pollen and when this occurs no fruit will set. The bees of the neighborhood may also be poisoned.

Label poisons so that you will know just what they are.

Keep poisons away from children and domestic animals.

When using a solution of a strength that may damage foliage, spray but one or two plants at first. If no damage results after three days, it may be safely applied on a larger scale.

Never use a tin vessel in making the Bordeaux mixture or other solution containing copper.

Have a good spraying outfit, one especially adapted to the work in hand.

Spray in Time—A plant cannot be saved after it has been half destroyed by insects; nor will it fully recover after its tissues are infested with a fungous disease.

TABLE OF PROPORTIONS

Where the terms, 1 to 800 parts, 1 to 1,000 parts and 1 to 1,200 parts are used, the following table will be found useful for converting these proportions into the fractional parts of a pint to be used with each 100 gallons of water.

1 part mixture to 800 parts water =

1 pint of mixture to 100 gallons water

1 part mixture to 1,000 parts water =

$\frac{4}{5}$ pint of mixture to 100 gallons water

1 part mixture to 1,200 parts water =

$\frac{3}{5}$ pint of mixture to 100 gallons water



Plate III

Strawberry Leaf Blight

CHAPTER II

Materials Used in Spraying

Fungicides are substances used in destroying *fungi*, which are low vegetable organisms causing disease in plants. More correctly speaking, the fungicide acts as a preventive of plant disease by obstructing the germination of the spores of the fungi causing such disease. Since these spores grow upon the exterior portion of plants, if we cover the plants with a coating of copper salt or other chemical deleterious to the germination of the spores, the reproduction of the fungi is held in check and thus plant disease is prevented.

Insecticides are substances used in killing *insects*. Those used in spraying are readily divided into two general classes: The internal poisons and the external contact irritants, known also as the internal and external contact insecticides. The internal poisons are only used for insects with biting mouth parts and they kill because of their poisonous action. The external contact insecticides act by their penetrating and irritant qualities and while more or less useful for the destruction of all insects, they are especially used against all insects whose mouth parts are formed for sucking.

Bordeaux Mixture—This is one of the standard fungicides and consists of a combination of copper sulfate, fresh lime and water. As it is used for the prevention of nearly all fungous diseases, its proper preparation is a matter of considerable importance. The proportions and manner in which the various ingredients are combined so largely

affect the resulting mixture that it would be a difficult matter to make identically the same mixture twice in succession.

Of the various formulas recommended, the one known as the 5-5-50 is now accepted as standard. This is composed of the following ingredients:

Copper Sulfate.....	5 pounds
Quicklime	5 pounds
Water to make.....	50 gallons

For preparing on a small scale the copper sulfate should be dissolved in 25 gallons of water, using a half barrel for such purpose. To dissolve the copper sulfate readily, it should be placed in a coarse cloth bag and suspended in the water so that the sulfate is just covered. It will not dissolve readily if the copper sulfate is placed at the bottom of the vessel. The *fresh* lime should be dissolved in another vessel, using only a small amount of water at first, adding more as the process of slaking progresses. Then dilute to 25 gallons. The copper sulfate solution and the milk of lime should then be poured together into a third vessel, which may be the spray barrel. It is best to strain the materials when pouring them together. For such purpose a copper strainer of about 20 meshes to the inch is best. It is important that practically equal amounts of the two solutions are poured together at the same time as illustrated in Fig. 6. Do not pour the copper sulfate into the milk of lime or vice versa, but both together into the third vessel. Otherwise the proper chemical combinations will not take place, sediment will form in the bottom of the spray barrel which will produce clogging at the nozzle and the proper results will not be obtained by the spraying.

If only a limited amount of the Bordeaux mixture is to be used, this method of its preparation should be followed. If, however, extensive orchards are to be sprayed the following methods should be employed:

Stock Solutions of Lime and Copper Sulfate—

Weigh out a given number of pounds of fresh lime. Slake the lime by the addition of a small amount of water at first and finally add enough to make a volume in gallons equal to the number of pounds of lime used. When this milk of lime is thoroughly stirred, each gallon of the solution will contain one pound of lime.

Dissolve any number of pounds of copper sulfate in water and then add enough more water to make a total volume in gallons equal to the number of pounds of copper sulfate used. A gallon of this solution when thoroughly stirred will contain one pound of the sulfate. Use only a copper or granite-ware measure. Both of the stock solutions can be kept almost indefinitely *if* proper measures are taken to prevent evaporation of the water.

It is always advisable in extensive spraying operations to prepare the Bordeaux mixture on a raised platform conveniently arranged so that the spray mixtures can be drawn off into the spray barrels by gravity. A convenient water supply will materially aid in saving time during the busy spraying season.

A properly prepared Bordeaux mixture is of sky blue color. With inferior or partly air slaked lime a greenish hue results. In such case the proper chemical combinations *have not* taken place and *damage* to the foliage is apt to result. Damage to foliage is the result of too little lime. A good method of testing the mixture is to dissolve an ounce of yellow prussiate of potash in five ounces of water and place in a bottle for use. After thoroughly stir-

ring the mixture add two or three drops of the prussiate of potash. If a reddish-brown color is formed it indicates that free copper is present and more lime is needed. If no discoloration takes place it shows that sufficient lime has already been added.



Fig. 6

Making Bordeaux Mixture

Lime-Sulfur Solution—This combination was first used on the Pacific coast as a winter spray for the destruction of scale insects. In more recent years, however, it has proved of great value in the control of fungous diseases. It is thus both an insecticide and fungicide, and, with arsenate of lead added to it, we have in a single spray an efficient contact insecticide, food poison and fungicide.

As a winter application to fruit trees the lime-sulfur will do more good than any other methods for the control of pests. A winter application will destroy the San José scale, the eggs of the green aphid, the branch form of the woolly-aphid, and many other insects which may be hibernating upon the sprayed trees.

Commercial Lime-Sulfur—Manufacturers have liquid stock solutions now on the market, requiring only dilution with water for use. Directions are furnished with this stock solution yet the Baumé hydrometer for testing the stock solution as per following table will be found convenient.

Dilution Table for Different Strengths of Lime-Sulfur

Baume Test of Stock Sol.	— Strength Desired —				
	1 to 8	1 to 20	1 to 30	1 to 40	1 to 50
	Dilutions below based on varying Baume Tests, show equivalents to proportions above				
36	1—9½	1—22½	1—34	1—45½	1—57½
35	9	22	33¼	44	55½
34	8¾	21	32	43	53½
33	8¼	20½	31	41	52
32	8	20	30	40	50
31	7½	19½	29¼	38½	48
30	7¼	18½	28	37	46
29	7	18	27	35½	44½
28	6½	17½	26	34	42½
27	6¼	16½	24½	33	41
26	6	16	23½	31	39
25	5½	15	22¼	30	37
24	5¼	14½	21	28½	35½
23	5	14	19	27	33½
22	4¾	13½	18¼	26	32
21	4½	12½	17½	24½	30
20	4	12	17	23	28

Dry Lime-Sulfur—Powder form is manufactured for convenience in handling. Should be mixed with water as directed by the manufacturer.

Self Boiled Lime-Sulfur—This is a method of making the solution without the trouble of boiling. When prepared in this way the solution is not injurious to tender foliage, such as the peach, and is thus *the only preparation of lime-sulfur which should be used as a summer spray.*

Stone-lime	8 pounds
Flowers of sulfur	8 pounds
Water to make.....	50 gallons

Put the lime in a barrel and add enough water to nearly cover it. Pass the sulfur through a sieve and as the lime slakes, add the sulfur to it, adding water as may be necessary and thoroughly stirring during the process of slaking. The lime will produce enough heat to boil the mixture several minutes. As soon as it is well slaked, water should be added to cool the mixture and prevent further cooking. It is then ready to be strained into the spray barrel, diluted and applied. In making this solution it is important to stop the cooking at the right time, as above directed, for otherwise the sulfur goes into solution and would be injurious to the foliage.

As a summer spray the self boiled lime-sulfur is especially useful for the control of apple scab and does not give the ill effects upon the fruit as is sometimes the case when Bordeaux mixture is used.

Arsenate of lead may be added to the self boiled lime-sulfur solution.

Sulfur Glue

Formula:

Flowers of Sulfur (superfine).....	8 pounds
Hydrated or masons lime.....	4 pounds
Ground Glue	1½-2 ounces
Water to make up to	50 gallons.

For each 50 gallons of spray mixture prepared dissolve 1½ to 2 ounces of ground glue in 3 gallons of boiling water.

Weigh out 8 pounds of sulfur and 4 pounds of hydrated lime; mix well and add slowly to the glue solution. The particles of sulfur and lime will readily become coated, forming a batter-like mixture. Let stand at least an hour, then dilute to 50 gallons with water.

Ammoniacal Copper Carbonate—This solution is advised in some cases for the summer spraying of ornamentals or mature fruit, as it causes no discoloration. It is made as follows:

Copper carbonate	5 ounces
Ammonia	3 pints
Water to make.....	50 gallons

Add enough water to the copper carbonate to make a thick paste. Dilute the ammonia with three parts water, add it to the paste, and then dilute with 50 gallons of water.

Arsenate of Lead—This is the best insecticide of the stomach poison class and is now practically the only one used. It adheres well to the foliage, remains suspended in the water, thus causing an even distribution, and shows white on the foliage, thus showing where the spraying has been done. Also it does not injure the foliage, as is the case with many of the other poisons formerly extensively used in spraying. Some fruit flies, such as occur on the late varieties of cherries, may be controlled by spraying the foliage with the sweetened lead arsenate. The mature flies lap up the poison and are killed before laying their eggs. For most purposes the molasses is not added, as it lessens the adhesive quality of the lead arsenate.

Arsenate of lead may be purchased in either the powder or paste form. As a rule one pound of arsenate of lead powder has as much strength as two pounds of the paste form.

Nicotine Sulfate—This is a standard tobacco product containing 40 per cent nicotine. It should not be confused with tobacco extract, which is an aqueous extract of tobacco containing its soluble ingredients.

For use, it is diluted with from 800 to 1,600 parts water, depending upon what insects are to be destroyed.

The nicotine sulfate is a dependable remedy for many of the sucking insects, especially the plant lice. It kills by contact, and during recent years has come into extensive use where kerosene emulsion and other insecticides of the external contact class, were formerly used. Its great advantage is that it does not injure foliage and combines well with other insecticides and fungicides.

When the nicotine sulfate is used alone it is desirable to add two pounds of dissolved soap to every fifty gallons of solution. This acts as a spreader and makes a more efficient insecticide. The soap should not be added, however, when the nicotine is combined with other spray solutions. The soap should be dissolved in the water first, then the nicotine added.

Special Preparations—Many of these are upon the market, some of which are most excellent, especially for certain purposes. Up to a few years ago many of these special preparations were unreliable and could not be recommended. But there has always been a demand for ready prepared and concentrated preparations requiring only the addition of water for use.

Since the passage of the National Insecticide Law of 1910, the marked improvement of these preparations has been so great that many of them are today replacing the

use of the standard insecticides and fungicides. Ready prepared Bordeaux mixture and the lime-sulfur solution are preferable when spraying on a small scale. Various miscible oils, requiring only dilution with water, are also preferable for the destruction of scale insects, while various coal tar products are most excellent for the destruction of lice on domestic animals and mites in poultry houses. Nicotine sulfate under various trade names has become a standard remedy for plant-lice.

For obvious reasons, in justice to all, these preparations cannot be mentioned by name in this work. The fact that any preparation has been on the market for a number of years is a good indication that the article has merit.

Insecticides Combined With Fungicides—In all spraying operations it is often desirable to combine several substances into a single solution, so that a variety of insects may be destroyed and fungous diseases prevented. To do this properly, one must know just what insects and fungous diseases are present and the remedies for each. With this information, the proper combination is easily made up so as to accomplish in a single spraying what would otherwise take several operations to accomplish.

Do not mix any miscible oil preparation with lime-sulfur.

Soluble or Miscible Oil

Some commercial houses make brands of oil that readily mix in cold water.

These are used for dormant applications against the various scales. Also used largely in the spraying of citrus trees.

Spraying on a Small Scale—The average city resident, or even suburbanite, has only a few trees or plants to spray. The following information will then be useful.

For all leaf-eating caterpillars or chewing insects, use one teaspoonful of arsenate of lead to one gallon of water.

For all plant lice, use one teaspoonful of nicotine sulfate to one gallon of soapsuds.

For red spider and mildew, dust the plants with dry sulfur.

For plant diseases, use five teaspoonfuls Bordeaux paste to a gallon of water.

CHAPTER III

Spray Pumps and Outfits

Best Outfits Only—It does not pay to waste time in the use of poor outfits. A pump that is continually getting out of order had better be thrown away. All working parts should be made of brass. Iron soon corrodes by the action of the spray chemicals. A rubber valve is soon swelled. Use only an outfit suited for the purpose in hand and have several outfits where necessary.

Bucket Spray Pumps—One of the many styles of this class of sprayers is shown in Fig. 10.

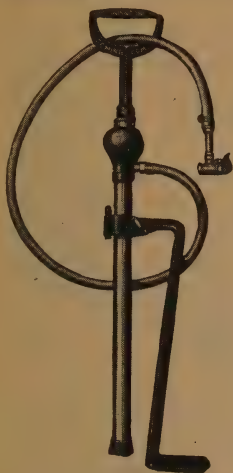


Fig. 10
Bucket Sprayer

A good bucket sprayer, with a proper nozzle and made with all brass working parts, is a very practical and convenient apparatus. They are useful in all spraying operations on a small scale and also useful in washing buggies, whitewashing, and for fighting fire. A nozzle, such as the Bordeaux, which throws either a solid stream or a spray, is the best for this style of sprayers.

Knapsack Sprayers—Some years ago the knapsack sprayer was more popular than at present, as operators have found it tiresome to carry five gallons of spray liquid on the back. To lessen these objections the author has suggested certain improvements, the result being shown in the pattern illustrated in Fig. 11. This form of knapsack sprayer can be readily changed into a bucket sprayer by removing the

lever and long handle and substituting the handle which is attached to top of tank.

They are of special use in spraying small vineyards, garden vegetables and potatoes.

Barrel Spray Pumps—These are force pumps fastened to the side or end of an oil or whisky barrel. Of the many styles on the market those with a submerged cylinder, as shown in Fig. 12, are perhaps preferable. A good mechanical agitator is absolutely essential in a barrel sprayer. The hose sec-



Fig. 12
Barrel Sprayer



Fig. 11
Knapsack Sprayer

tions should be of varying length, depending upon the work to be done.

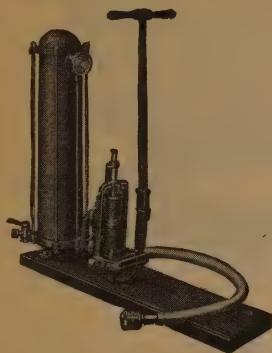
When the spraying is done by the operators standing in the wagon, 10 to 12-foot sections are sufficient, but with large trees where the operators work from the ground, longer hose is essential. Every barrel sprayer, or any other outfit with two sections of hose should be provided with a three-way cock. This will enable the spray to be shut off from either one or both hose sections and there is thus no waste of materials.

Compressed Air Outfits—

The general character of these sprayers is shown in Fig. 13. With them the work of pumping is exceedingly easy. The outfits consist of an air-tight receptacle and an air pump. They are convenient for small work.

**Fig. 13****Compressed Air Sprayer**

The "Tank" Sprayer—A very popular type of hand

**Fig. 14. Tank Sprayer**

sprayer—a development of recent years—is the "tank" sprayer, so called because it is much used in connection with vertical or horizontal tanks of 50 to 150 gallons capacity.

This type of sprayer is capable of developing a higher pressure than can be secured from a barrel pump, and with less expenditure of effort, due in part to the use of the upright lever. It also has a greater capacity than any barrel pump.

Next to the gasoline engine driven sprayer, the "tank" sprayer is undoubtedly the most efficient for the orchard of four to ten acres.

Power Sprayers—If more than five acres are to be sprayed, a gasoline engine driven outfit is to be preferred.

It will maintain a steady pressure and will soon pay for itself in saving of time. Gasoline sprayers where the power is furnished by a gasoline engine of from two to five horsepower are now becoming quite popular in all large spraying operations. Spraying is such an essential practice in parks and large orchards, that the first cost of an outfit is not nearly so important as the saving of time and labor, and the convenience which is obtained with a gasoline sprayer. The general character of these outfits is shown in Fig. 15.

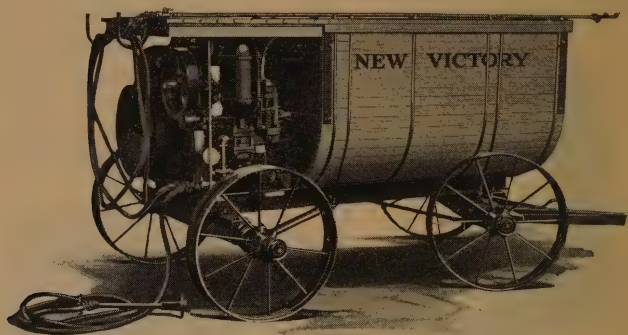


Fig. 15
Gasoline Engine Sprayer

Extensions—In spraying trees, especially where the hose is operated from the ground, some arrangement is necessary whereby the nozzle is held near the foliage or branches. This may be accomplished either by means of an extension pipe or a spray gun. An extension pipe should consist of a quarter inch brass tube inside of a bamboo pole. This will be found to be much lighter and more easily handled than an ordinary iron pipe.

Field Sprayers—In spraying low growing crops on a large scale it is quite important to have an outfit arranged with several nozzles adjustable in position so that several rows of potatoes or other crops can be sprayed at a time. Such an outfit is shown in Fig. 17. Generally all that is needed is the regular barrel sprayer placed in a wagon and arranged with several leads of hose and nozzles. Special outfits of this nature are on the market.

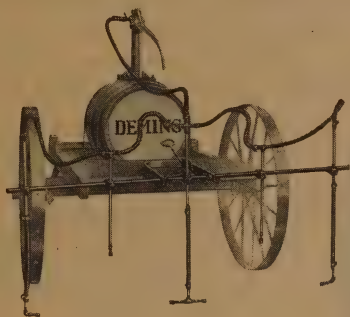


Fig. 17. Field Sprayer

Nozzles—The nozzle is perhaps the most important feature of a spray outfit. What is wanted in all spraying operations is the application of a *fine mist* and not *drops* of the liquid. A *perfect* nozzle throws the liquid a considerable distance in a fine mist-like spray, *without waste* of materials. The three best known nozzles are as follows:



Fig. 18
"Simplex" Nozzle

The *Vermorel* shown in Fig. 19 undoubtedly throws the finest spray of any. In its use the nozzle should be held quite near the foliage or branches, as the liquid is not thrown out with much force.



Fig. 19
Vermorel Nozzle

The *Bordeaux*, shown in Fig. 20, is the best all-around nozzle, and where but one is used this style should be the pattern selected. The *Bordeaux* has the advantage over all other spray nozzles in that the character of the spray is readily changed from a solid stream to a mist-like fan-shaped spray. Should there be any clogging of the nozzles with the spray material, it is easily remedied by turning the handle, thereby forcing out the obstruction with the pressure of the pump.



Fig. 20
Bordeaux Nozzle

The *Simplex*, shown in Fig. 17, is much used on the larger hand spraying outfits and on power sprayers.

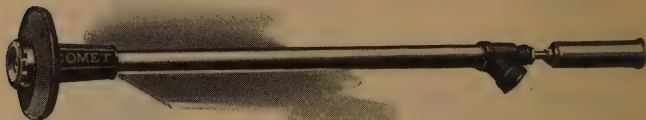


Fig. 21
The Spray Gun

The spray gun is an adjustable nozzle of large capacity and is in general use with gasoline engine driven outfits.

It ranges in length from eighteen to twenty inches. By a simple operation of the hand the spray may be adjusted from a fine wide mist for spraying near at hand, to a long driving spray which will reach the highest parts of the tree or it can be shut off completely. For good results the pump should furnish a minimum of 5 to 10 gallons per minute at 175 pounds pressure.

The Proper Outfit—The particular outfit to be selected will depend altogether upon the amount and character of the work to be done. For spraying on a small scale the bucket or knapsack pattern, with extension hose, will be all that is needed. For orchard work a barrel sprayer is essential. In large orchards or public parks, the power sprayers should be used. No one outfit can be expected to suit all the varying conditions of spraying. That style should be selected which is best suited for the work in hand. The more expensive outfits are often the cheapest in the end for they are the most saving of labor.

Care of an Outfit—A spray pump, like any machine, will do good work and last in proportion to its care. When an outfit is first received, it should be carefully studied, that its working principles may be thoroughly understood by the person using it. When a pump does not work properly, the cause of the trouble should be ascertained at once and remedied, otherwise permanent damage may result. After using, clear water should be run through the sprayer to remove any sediment that might otherwise remain. When the spraying is over for the season, the pump should be thoroughly cleaned. With reasonable care the pump proper will last several years. The hose, however, will probably have to be replaced after one or two seasons' use.



One of the handiest implements about the place is the little bucket sprayer for which a multitude of uses such as spraying, whitewashing, disinfecting, etc., may be found.

In the above illustration, a government agricultural agent is showing a Georgia gardner how to keep his potatoes free from bugs and blight. Ordinarily, these outfits are equipped with sufficient hose for but one person to operate, but in the above photo, extra hose has been provided so that two persons could co-operate in the work.

CHAPTER IV

Summary of Spraying Plants

APPLE

Summary of Treatment—Practically all of the many insect and fungous enemies of the apple can be remedied by three or four sprayings during each spring. The first spraying should be given when the leaf buds show green tips; the second when the blossoms show pink; the third after the blossoms have fallen; and the fourth spraying three weeks later. In the first two sprayings the lime-sulfur with addition of nicotine sulfate is preferable, especially if scale insects and aphids are present. In the last two sprayings, use Bordeaux mixture, or the self-boiled lime-sulfur with arsenate of lead added. Each tree should be looked over carefully during the winter and all dried up fruit removed, the loose bark scraped off, and any old leaves still adhering carefully picked off and burned.

Borers in Trunk—Go over the trees in autumn and with a knife remove any borers which may be just starting their work. In spraying with lime-sulfur and arsenate of lead make application upon the trunk as well as upon the branches. If borers are numerous apply in spring a white-wash containing soft soap and crude carbolic acid. Fig. 23 shows a common form of the apple-tree borer.



Fig. 23

Apple Tree Borer

Scale Insects—The most common are the Oyster-shell scale, the Scurfy scale and the San José scale. The first shown in Fig. 3, is elongated, much resembling in form an oyster shell but of a dark color. The Scurfy scale, shown in Fig. 4, is elongated and of a light grayish color.

The San José scale, shown in Fig. 1, appears as a gray incrustation upon the bark, each scale having a prominent raised black center. It is important to know what scale is present as explained on page 16, which see.

To destroy the Oyster-shell scale or the Scurfy scale, spray the trunk and larger branches in May or June, just as the young are hatching, with nicotine sulfate, 1 to 800, or a miscible oil preparation. The young appear as minute light colored specks and it is important that the remedy be applied at just the right time to accomplish results. To keep the San José scale in check spray with the lime and sulfur solution or a miscible oil preparation. This can be done at any time during the dormant season, but if the scales are present in large numbers, two sprayings—one in autumn and one in early spring—are recommended.

The Woolly Apple Aphis—This insect, shown in Fig. 24, works on both the roots and trunk and larger branches. When new trees are set out they should be carefully examined for this insect, and if present dip the roots in



Fig. 24
Apple Aphis

nicotine sulfate or a miscible oil solution. If present upon the trunk or branches, first scrape off all loose bark and spray with one of above solutions. There is both a winged and wingless form and the insect may

be readily distinguished by the white down, somewhat resembling cotton, upon the abdomen.

Other Apple Aphids—There are three species of plant lice which attack the buds and leaves of the apple: the bud aphid, the rosy aphid, and the leaf aphid. Treatment consists of a spray of nicotine sulfate, 1 to 1000, before the buds appear. Make another spraying if the aphids are numerous but spray before they cause the leaves to curl up.

Apple Red Bug—The eggs of these insects are laid on the smaller branches in autumn, the young hatching in early spring. They feed on the foliage and puncture the newly set fruit, causing it to drop off a little later, or to become knotty and misshaped. Treatment consists of a spray of nicotine sulfate 1 to 1000 before the blossoms appear and a second spraying after the petals fall, combined with the arsenate of lead for the codlin moth.

Various Caterpillars—There are a variety of these; the canker or "measuring worms"; spring and fall web worms; leaf roller; case bearers, and others. They are all leaf eaters and are hence easily killed by spraying with arsenate of lead.

Bud Worms—These are small caterpillars which eat the leaves before they open in the early spring. They may be destroyed by spraying with arsenate of lead before the leaves open. Where the trees are sprayed with the lime-sulfur or Bordeaux mixture and the arsenate of lead for a general treatment, special treatment is not necessary.

Leaf Crumpler—This insect passes the winter upon the trees, securely fastened between two leaves which generally adhere to the branches. Go over the trees in winter and pick off all remaining leaves and burn. Where this has been neglected, spray with arsenate of lead in June for the destruction of the caterpillars.

The Codling Moth—This is perhaps the principal insect enemy of the apple, being the cause of wormy apples and pears, and is shown in Fig. 25. The eggs are laid about the time the trees bloom, and later a second brood of moths lay their eggs upon the growing fruit. The trees should be sprayed with arsenate of lead just after the blossoms have fallen and again three weeks later.

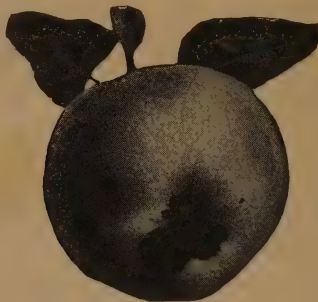


Fig. 25

The Codling Moth

Apple Maggot—This is a small white worm that tunnels through the fruit. The eggs are laid by small flies the last of June or early July, who insert their eggs into the skin of the fruit. The winter is passed in the ground in the pupa stage. Treatment consists of spraying with arsenate of lead, three pounds to fifty gallons, with a gallon of molasses added for sweetening. This spraying should be done the last of June, the object being to kill the flies before the eggs are deposited.

Apple Scab—This is a widespread disease which shows itself on both the fruit and leaves in the form of dark

colored spots as shown in Plate II. It is always more or less prevalent and can be prevented by spraying with Bordeaux mixture or lime-sulfur. Make the first application as the buds show pink, the second after the petals fall, and the third three weeks later.

Apple Blotch—Increasingly important disease. Causes fruit to dry and crack on portions of the surface with gradual extension of pithy flesh of apple. Also causes cankers on young limbs and twigs. Best controlled by three sprays of Bordeaux mixture. 4-4-50. The first one three weeks after petals fall and the other two following at intervals of about twenty-one days.

The Bitter Rot—This disease causes the fruit to rot before ripening. Easily identified in more advanced stage by concentric rings formed by the dot like spores. It can be prevented by spraying with the self boiled lime-sulfur, making the first application early in July and another application three weeks later.

Twig Blight—See Fire Blight of Pear.

Other Diseases of the apple include black rot, leaf blight, fly speck, powdery mildew and rust. The application of Bordeaux mixture or lime-sulfur as given under the head of general treatment for the apple will prevent all these diseases.

ASPARAGUS

Beetle—Dust the plants with freshly slaked lime early in the morning. Leave a row or two uncut and spray these plants with arsenate of lead.

Rust—Spray with Bordeaux mixture, three applications at intervals of ten days, as soon as the crop is off. Or dust with flowers of sulfur early in the morning while the dew is still on the plants.

BEAN

Anthracnose—This is a disease causing brown spots on the pods. Spray with Bordeaux mixture three times, making the first application when the plants are about five inches high, and repeat at intervals of two weeks.

Do not raise beans on land which has been infested the year previous, and select seed from healthy pods in fields where the disease is not present.

Leaf Beetle—There are two species of these, one being the bean lady beetle. Both eat the leaves and are readily destroyed with arsenate of lead spray.

Aphis—Spray with nicotine sulfate 1 to 1000, as soon as the insects appear.

BEET

Leaf Spot—Leaves first appear spotted, then wilt, causing a heart rot to appear. Spray with Bordeaux mixture when the plants are six inches high and again two weeks later.

Army Worm—This is a leaf eating caterpillar, easily destroyed by arsenate of lead. There is also a web worm, having similar habits.

Flea Beetles—These often occur in immense numbers, doing considerable damage. Remedy lies in Bordeaux mixture. While this is not considered an insecticide, yet the fact remains that it is the best repellent for these beetles known.

BLACKBERRY

Same as Raspberry, which see.

CABBAGE

Caterpillars—There are several species, the most common of which is the green worm which hatches into a

white butterfly. The best remedy for these worms is a spray of arsenate of lead. As the cabbage grows from within outward, there is no danger in the use of this poison.

Cabbage Aphis —

These plant-lice are especially numerous during cool dry weather. Best remedy is a spray of nicotine sulfate. 1 to 1000, with

soap added as a spreader. It is best to make up a soap-suds first, and then add the nicotine.

Harlequin Cabbage Bug—Use a trap crop of mustard planted in November and in bloom in March. Destroy the insects in March by spraying with pure kerosene. If all the bugs which live over winter are then destroyed, the cabbage crop will be saved. This insect occurs only in the Southern states.

Cabbage Maggot—This is the larva of a small fly which eats into the roots of cabbage, radish, cauliflower and turnip plants. It is an exceedingly hard insect to control. Seed beds should be protected by means of cheese cloth to exclude the flies and prevent egg-laying. In the field good results are obtained by the application of an emulsion made with soap and carbolic acid, diluted with thirty parts water. Remove a little of the earth from around the plants and spray the emulsion on with



Fig. 26
Cabbage Worm and Butterfly

force. Another method is to put a pint of kerosene in three gallons of sand and place a little of the sand around each plant.

CELERY

Caterpillars—A green, black and yellow worm which feeds on the leaves. Spray the plants with arsenate of lead.

Blight—There are two diseases which attack the celery plant, causing the leaves and stems to become discolored, thus lessening the market value of the product. The plants in the seed-bed should be sprayed with ammoniacal copper carbonate as soon as they are up and continued at intervals of two weeks until transplanted, or longer if indications of disease are present.

CHERRY

Aphis—The black plant lice infest the leaves and tender tips. Spray with nicotine sulfate 1 to 800, with soap added. As the aphids are on the underside of somewhat curled up leaves, care must be taken to direct the spray directly upon the insects.

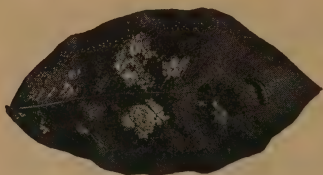


Fig. 27
Cherry Slug

Slug—Shown in Fig. 27. Spray with arsenate of lead.

Fruit Flies—These are the minute larvae next to the pit in late ripening varieties. The mature insects are small flies which lay their eggs under the skin of the fruit late in June. Spray the trees the last of June with

arsenate of lead sweetened with a gallon of molasses to every fifty gallons of the spray. The object is to destroy the flies before the eggs are deposited.

Curculio—Same as the plum curculio, which see.

Brown Rot—This disease causes irregular spots on the leaves and a rotting of the fruit on the trees. Spray with either Bordeaux mixture or lime-sulfur just before the blossoms open, just after the petals fall and again three weeks later.

Powdery Mildew—This affects both the twigs and leaves, causing the latter to fall. Spray with lime-sulfur or dust with powdered sulfur.

CITRUS TREES

Orange, Grapefruit, Lime, Lemon, Etc.

Anthraxnose—Blossoms that fall from attack of anthracnose show brick red pustules in the lesions. The diseased areas on fruit are sunken and of a grayish color. Spray with ammoniacal copper carbonate solution or weak Bordeaux mixture.

Mites—For attacks of "red spider," six-spotted mites and "rust-mite," spray with lime sulfur, one gallon 33 degrees Baumé to 75 gallons of water. See spray schedule under "Whitefly."

Scab—Shows in rough, warty growth. Spray with ammoniacal copper carbonate. Spray first when the flowers fall; second, two or three weeks later; third, two or three weeks later, or when blooming is nearly or quite over; and fourth, about three weeks later.

Scales—Spray spring and fall with miscible oil, proportions of one gallon actual oil to 100 gallons water.

Thrips—When spraying in bloom for anthracnose or scab add nicotine sulfate at rate of one pound to 125 gallons spray. For thrips alone, use one pound nicotine sulfate and 2 gallons lime-sulfur solution to 140 gallons water.

Schedule for Whitefly, Scale, Rust Mite, Red Spider, Etc.

It may be necessary to spray for rust-mite before May first, using 33 degree Baumé lime-sulfur 1-50 or 1-75; or if red spider becomes abundant the lime-sulfur spray should be used, but generally speaking the following schedule will be sufficient.

(1) *About May 1st*, before the rainy season commences, and when the fruit is an inch or more in diameter:

Spray with miscible oil. This kills scale and whitefly, and to a large extent, rust mites.

(2) *June to July*, before any russetting appears: Spray with lime-sulfur, one gallon to fifty or one gallon to seventy-five gallons of water.

(3) *August 5th to August 31st*: Second spraying with miscible oil for scale and whitefly and to clean off sooty mould.

For rust mite, add soda-sulfur, one gallon to fifty gallons spray.

(4) *November and December*: Spray with lime-sulfur 1-50 or 1-75 to kill rust mite. This may or may not be necessary.

Soda-sulfur: Note the proportion of soda-sulfur is 1-50 *with oil sprays* and 1-40 *with water*.

Lime-sulfur should not be mixed with miscible oils.

Soda-Sulfur Spray

Caustic Soda (96%).....	20 pounds
Flowers of Sulfur.....	30 pounds
Water	20 gallons

Mix the sulfur to a paste, not sloppy, with cold water in a barrel; to this add the caustic soda, and as it boils, add gradually twenty gallons of water to prevent burning, not putting in enough at any time to drown the boiling. Use for rust mites 1-50 with miscible oil sprays. It may be used alone 1-40 but is not so effective as lime-sulfur 1-50 to 1-75.

CORN

Insects—There are a great variety of insects which attack corn, such as the army worm, wire worm, white grub, root aphid, cut-worm, grasshoppers and chinch bug. Corn should not be planted on newly turned sod. Clean culture and rotation of crops should be practiced. Cut-worms and grasshoppers may be destroyed by means of the poisoned bait as given on page 14.

CUCUMBER

Same as Melons which see.

CURRANT

Worm—To destroy, spray with arsenate of lead. As the worm will entirely strip the bushes of leaves in a few days the plants should be closely watched early in the spring and the applications made just as soon as the worms are noticed.

Striped Plant Bug—A yellow black striped insect which punctures the leaves. Destroy the eggs by cutting off and pruning the tips of the shoots in early spring. Destroy the young nymphs with nicotine sulfate.

Cane Borer—Destroy the infested canes in early spring.

Aphis—Spray with nicotine sulfate as soon as they appear, being careful to make the application to the underside of the leaves.

FLOWERS

Caterpillars—A great variety of leaf-eating caterpillars occur upon all kinds of ornamental flowering plants. They may all be killed by spraying with arsenate of lead.

Plant Lice and Mealy Bugs—These occur quite often in hothouses, especially where plants have been neglected. All affected plants should be sprayed with nicotine sulfate.

Red Spider—This is very common on indoor plants. All infested plants should be dusted with powdered sulfur. In greenhouses, watering the plants with considerable force is good.

Plant Diseases—In greenhouses these are numerous and varied. Their presence generally indicates a lack of careful attention and ventilation. When new plants are set fresh soil should be used. Spray all infested plants with Bordeaux mixture every ten days.

GOOSEBERRY

Leaf-Spot and Worm—Same as on Currant, which see.

Mildew—A powdery mildew which is very common on the English varieties. Spray with Bordeaux mixture before the leaves open and again after blossoming.

Aphis—Same as on Currant, which see.

GRAPE

The Black Rot, Downy Mildew, Powdery Mildew and Anthracnose—Four distinct diseases attack the grape,

the effects of which are very much the same. The remedies also are practically the same. The vines should be given a thorough spraying with Bordeaux mixture before the buds swell in the early spring. The Bordeaux mixture should then be applied every two weeks until the fruit begins to ripen.

If ammoniacal copper carbonate is used for the last two sprayings, it will not show on the fruit, like the Bordeaux.



Fig. 28

The Army Worm—A Common Vegetable Pest

Leaf Hopper—A small yellowish green insect which sucks the sap from the underside of the leaves. Spray with nicotine sulfate and soapsuds, 1 to 1000.

Rose Chafer—This is a gray beetle occurring in large numbers on sandy soil, often doing considerable damage to grape vines. At the first appearance of the beetle, spray the vines with arsenate of lead at the rate of three pounds powder to fifty gallons, adding one gallon of molasses to the spray solution.

Worms—There are several species of caterpillars and also a slug which eats the leaves. These may be readily

destroyed with a spray of arsenate of lead.

MELON

Aphis—Found mostly on the underside of the leaves. Spray with nicotine sulfate, 1 to 1,000, using an undersprayer for the purpose.

Flea Beetles—Spray with Bordeaux mixture, which makes a good repellent for these insects.

Striped Cucumber Beetles—Heretofore considered a difficult pest to combat. As they eat the leaves, in *theory* we should apply arsenate of lead for their destruction, but this seems to have little effect upon them, or else they find areas not covered with the poison. They are easily controlled, however, by simply scattering over the plants either flour or corn meal. The beetles eat the flour or meal, swell up and die. This treatment is also effective for the spotted cucumber beetle.

Pickle Worm—Quite common in the southern states. Kill the worms before they enter the fruit by spraying with arsenate of lead when the fruit begins to form.

Cucumber Mildew—A fungous affection causing the leaves to turn yellow or brown in spots. Spray with Bordeaux mixture three or four times at intervals of two weeks making the first application when the vines are nearly half grown.

The Melon Blight—A disease common in the South, caused by *bacteria*. No remedy is known for this disease. Do not plant melons on the same land year after year and do not have melons follow potatoes or tomatoes.

ONION

Mildew—Causes a wilting of the leaves. Spray with

Bordeaux mixture, making the first application upon the appearance of the third leaf and repeat every ten days during the growing season. As the Bordeaux by itself does not stick well to the leaves, add the following to each fifty gallons: Resin, two pounds; sal soda crystals one pound; water one gallon. Cook this in an iron kettle in the open, boiling for at least one hour, or until a clear brown liquid results.

Thrips—Spray with nicotine sulfate, 1 to 1200.

PEA

Mildew—A powdery mildew on the leaves and pods. Controlled by dusting with dry sulfur or spraying with Bordeaux mixture.

Aphis—Light green plant lice, sometimes occurring in large numbers. Spray infested plants with nicotine sulfate 1 to 1000 as soon as the insects are noticed.

PEACH

Scale Insects—The peach is attacked by a great variety of scale insects the worst of which is the San Jose scale. An orchard should be thoroughly examined at least once a year, and if any scale insects are present all infested trees should be sprayed with the lime and sulfur solution or miscible oil. If found only on a few trees of an orchard, dig out and burn. The lime and sulphur solution is most effective if applied just before the buds swell in the spring.

Curculio—Same as on Plum, which see.

Peach Aphis—Same as on Cherry Aphis, which see.

Leaf Curl—A curling of the peach leaves such as is shown in Fig. 29 is quite common after wet springs. The curled leaves fall off after some time and new leaves put forth, which necessarily weakens the vitality of the tree. Where the lime and sulfur solution is used for a winter treatment for scale insects, this disease will also be prevented.

The Brown Rot—This disease attacks all the stone fruits and is a serious and widespread fungous affection. It causes the fruit, or part of it, to rot before ripening and like most fungous diseases does its greatest damage during wet seasons. A familiar sight in the winter months in most peach and plum orchards is the "mummied" fruit which still adheres to the branches. As the disease is present in this mummied fruit the first step in the treat-



Fig. 29

Peach Leaf Curl

ment of an orchard should be the burning of all such diseased fruit. The mummies should not simply be picked and thrown to the ground, but they should be *burned*. At least once during the winter

the trees should be thoroughly sprayed with lime-sulfur. Soon after the blossoms fall, spray with the *self-boiled* lime-sulfur solution or sulphur glue. Then again with the

same solution three weeks afterward and still again about a month before the ripening of the fruit. The first two spring applications should have two pounds of arsenate of lead added to each fifty gallons of spray solution, in order to control the curculio.

Scab—A disease causing black spots on the fruit. Spray as above for brown rot.

Blight—Causes a spotting and gumming, resulting in death of the twigs and branches. Spray with lime-sulfur in November and again in February.

Red Spider—A common pest in a dry atmosphere, occurring on the underside of the leaves. A common remedy is the forcing of water against the underside of the leaves. The application of dry sulfur is excellent.

PEAR

Pear-Leaf Blight—This is a fungous affection which yields readily to Bordeaux mixture. Spray early in the spring making two or three applications.

Fire Blight—This is a widespread disease which occurs especially in the South. It is caused by bacteria which work entirely within the tree and no spray application will do any good whatever. The bearing trees should be made to grow as slowly as possible. Prune only in summer. Winter pruning promotes growth, while summer pruning retards it. Cut off affected limbs considerably below point of infection and dip the pruning tools in a bichloride of mercury antiseptic solution after each operation. Any pruning without this precaution will tend to spread rather than lessen the disease.

Codling Moth, Bud Moth and Scab—Same as Apple, which see.

Slug—Arsenate of lead spray, or dust with air slaked lime.

Blister Mite—A small mite which causes black blisters on the leaves. The mites winter under the bud scales and are killed by a winter spray of lime-sulfur.

Pear Psylla—Minute sucking insects which occur in the axils of the leaves in early spring. The mature insects are minute jumping lice. The young secrete a honey dew in which a black sooty fungous grows. There are three or four broods a season, often causing serious damage. Spray with lime-sulfur just before blossoming. Also at intervals during the spring with nicotine sulfate, 1 to 1000, with soap added.

Thrips—Minute sucking insects which attack the tender growth of the opening buds in early spring, causing a loss of the crop. The winter is spent in the ground a few inches below the surface. In California the pear thrips are a serious pest and are becoming distributed throughout the country wherever pears are grown. Clean culture and cultivation during the winter will destroy the hibernating young. Infested trees should be given a thorough spraying of nicotine sulfate in soapsuds 1 to 1,000, making the first application when the buds first open and the second application after the petals have fallen.

PLUM

Curculio—This insect, shown in Fig. 30, is common in every State east of the Rocky Mountains. The adults eat the tender foliage for some time before the fruit is “stung” and owing to this fact we have a good remedy in arsenate of lead. The trees should be sprayed three or four times at intervals of ten days, making the first application before the buds have opened. In large orchards spraying will prevent injury to a great extent, as great numbers of the adult insects will be killed before the fruit is stung. Where only a few trees are sprayed the effect of the insecticide will be the same in killing the adult insects, but as others will come from surrounding trees which are not sprayed and will sting the fruit on the sprayed trees, the latter will still lose a good per cent of their fruit. *Spray the trees of an entire orchard, not simply a few of them.* In spraying for the curculio it is only necessary to add the arsenate of lead to the lime-sulfur, when spraying for the brown rot.



Fig. 30
Plum Curculio

Aphis—Spray with nicotine sulfate, 1 to 1000, with soap added.

Brown Rot—The same disease as in the Peach, which see.

Shot-Hole Fungus—A disease causing holes in the leaves. Treatment is the same as for brown rot.

POTATO (Irish)

Potato Beetle—Spray with arsenate of lead when the beetles appear in the spring, which will generally be as soon as the plants are out of the ground. If the first brood were destroyed in a neighborhood there would be few or no second broods.

Potato Blight—There are two fungous affections of the potato, known as the early and late blight, but the treatment for both diseases is the same. The Bordeaux mixture should be applied as soon as the vines are nearly half grown and other applications made as soon as the first applications are washed off by rain. The vines thus treated will remain green and healthy long after the others have died. As the tubers do not begin to form until after the plants have blossomed, it is readily seen that vines treated with Bordeaux mixture will have a longer period of growth, and thus yield much more than others. Arsenate of lead should be added to the Bordeaux mixture when the beetles are present. To increase the yield, potatoes should be sprayed with the Bordeaux mixture, whether potato diseases are present or not.

Flea Beetles—Bordeaux mixture acts as a repellent for these beetles, so if they are present it may be necessary to apply the mixture very soon after the plants are up.

Scab—This causes the rough and uneven surface on the tubers and greatly lessens their market value. It may be partly prevented by soaking the uncut seed potatoes in formalin, 1 pint to 30 gallons of water, for two hours. Do not plant potatoes on land which has formerly yielded

scabby potatoes. The scab fungus does not develop in soil which is slightly acid, so it is best not to apply lime to potato land.

Tuber Moths—The mature insect is a moth which lays its eggs in both the tubers when in storage and the plant stems in the field. It is as yet not well distributed, but threatens to become one of the worst pests of all. It is easily distributed in seed potatoes. Clean culture and the digging of all small potatoes at harvest will help eradicate the insect. Do not leave dug potatoes in the field over night but store in a non-infested warehouse.

RASPBERRY

Fungous Diseases—Anthracnose causes scab-like spots on the canes, while the orange rust is often seen on the plants early in the season. Destroy infested plants by digging up and burning. Spraying with Bordeaux mixture early in the season will materially help. Plant in clean soil.

ROSE

Mildew—A common disease in greenhouses, especially where lacking proper ventilation. Florists paint the steam pipes with equal parts of sulfur and lime mixed in water. Outdoor plants should be dusted with dry sulfur.

Stem Blight—A disease causing scab-like patches on the larger branches, similar to the anthracnose of the raspberry. No cuttings should be made from such plants.

Leaf Blotch—A disease causing dark patches on the leaves. Lime-sulfur as a winter spray is quite effective as a remedy. Application of Bordeaux mixture in the spring before blossoming will greatly aid in keeping the rose bushes in a healthy condition.

Aphis—These materially affect the development of the buds and occur on the underside of the leaves throughout the summer. Spray with nicotine sulfate, in soapsuds, 1 to 1000.

Slug—Spray with arsenate of lead.

Thrips—These are the small sucking insects which feed upon the opening buds. They may be destroyed with a spray of nicotine sulfate in soapsuds, 1 to 1000.

Rose Chafer—Same as on Grape, which see.

STRAWBERRY

Slug—Pale green worms which eat the leaves, especially on young plants. To destroy these worms spray with arsenate of lead. This, of course, should not be done during the bearing season.

Leaf Blight—This is a common diseased condition of the leaves, as shown in Plate III. It rarely attacks new and thrifty beds. The plants should be sprayed three or four times a year with Bordeaux mixture, making at least one application before the blossoms open.

Other Insects—There are many other insects which attack the root and crown of the strawberry plant. Care should be taken in the selection of new plants and proper crop rotation. Plow up old beds as soon as possible after the crop has been picked.

SHADE TREES

Cottony Maple Scale—The presence of this insect (see Fig. 2) is indicated by a cottony mass of eggs, protruding from underneath the female insects on the underside of the main branches in May. The eggs hatch late in June and the young insects feed on the underside of the leaves, sucking the sap. Treatment consists of the winter application of lime-sulfur to destroy the hibernat-

ing females, followed early in July with a spraying of nicotine sulfate in soapsuds, 1 to 1000, to kill the young.

Elm Leaf Beetle—This is an imported insect, formerly found only in the eastern United States, but which has now become quite generally distributed. It causes so much damage that the planting of elm trees has been discouraged. The mature beetles hibernate in protected places in winter and feed on the new foliage in spring, making holes in the leaves. In June the young beetles of the first brood feed on the underside of the leaves, leaving the netted veins of the leaf intact. What remains of the leaves dries up and falls off. By August a second brood of young beetles appear.

Control of this insect lies in a spray of arsenate of lead, four pounds to fifty gallons. First spraying should be applied in the spring to kill the mature beetles, the second spraying in June for the young. This second spraying should be directed to the underside of the leaves, since the young do not eat the upperside.

Brown-Tail Moth—This is a destructive insect imported from Europe and as yet only distributed over the New England states. The mature insect is a snow white moth, which appears in July and deposits its eggs on the leaves of trees. The caterpillars hatching from these eggs become only partly mature during the season and hibernate in conspicuous nests at the tips of the branches. They complete their growth the following spring by feeding upon the tender foliage, causing great damage not only to all shade trees, but to those of the forest and lawn.

The three remedies for the control of the brown-tail moth are (1) destroy the caterpillars in the nests during the winter; (2) spray the trees in spring with arsenate of

lead; and (3) keep the caterpillars from ascending new trees with tree tanglefoot. The latter is a special sticky preparation, quite useful for the purpose. As the caterpillars are more than usually immune from the effects of poisons, it is best to use the arsenate of lead at a strength three times ordinarily used.

Gypsy Moth—This is another destructive imported insect, found as yet only in the New England states. The eggs are laid in autumn in masses about an inch long. The young caterpillars hatch in early spring and feed upon the leaves of trees, becoming mature in July and forming pupa inside of cocoons. The female moths do not fly.

Remedies consist of (1) collecting and destroying the egg masses in winter; (2) spraying in spring with arsenate of lead, seven pounds to fifty gallons; and (3) banding the tree trunks with tanglefoot.

Scale Insects—There are many scale insects which attack shade trees, the most important of which is the San José scale. All infested trees should be sprayed during the winter with lime-sulfur.

SQUASH

Beetles and Aphis—Same as Melon, which see.

Squash Bug—A stink bug which sucks the sap and is a very serious pest. Pick off adult bugs. Kill the young with a spray of nicotine sulfate in soapsuds, 1 to 1000.

TOBACCO

Horn Worm—This insect is quite prevalent and is very familiar to tobacco and tomato growers. The plants should be sprayed with arsenate of lead as soon as the worms are noticed. The knapsack sprayer will be found convenient for this purpose, although many growers prefer an application in the dry form.

TOMATO

Horn Worm—This is the same as on the tobacco.

The Blight—This is a disease quite common in the lower South. It produces a wilting of the plants and is caused by bacteria—not fungi. No remedy for this disease is known. Tomatoes should not follow potatoes, melons or tomatoes on the same land in case any wilting of any of these crops manifests itself.

Leaf Spot—This disease causes small spots on the leaf, until finally the whole leaf is consumed. Spray with Bordeaux mixture every two weeks, making the first application ten days after the plants are set in the field.



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REPRESENTATIVE LIST OF USES

WHITEWASHING poultry houses, stock yards, barns, cellars, warehouses, fences, etc.

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DISINFECTING barns, poultry houses, stock pens, etc.

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	No. of Packages	SIZE OF PACKAGE	Price per Package	AMOUNTS	
PRICES DELIVERED EAST OF THE MISSISSIPPI RIVER		SCALECIDE			
		50 gal. bbls.	\$38.00	.....	.....
		30 gal. bbls.	26.00	.....	.....
		15 gal. drums \$11.50			
		Drum extra 2.00	13.50	.....	.....
		(Cost of drum refunded when returned to Hackensack, N. J.)			
		2-5 gal. cans in case	10.60	.....	.....
		1-5 gal. can in case	6.25	.....	.....
		1 gal. "	1.75	.....	.....
		1 qt. "	.75	.....	.....
		SULFOCIDE			
		50 gal. bbls.	\$60.00	.....	.....
		30 gal. half-bbls.	39.00	.....	.....
		2-5 gal. cans in case	15.00	.....	.....
		1-5 gal. " "	8.75	.....	.....
		1 gal. cans	2.75	.....	.....
		1 qt. "	1.00	.....	.....
		1 pt. "	.70	.....	.....

Both Scalecide and Sulfocide are non-poisonous, and can be shipped by freight, express or parcel post. Unless otherwise indicated, prices are for freight shipment, but if you desire us to ship by express, we will make the shipment express charges collect and allow you freight to your railroad station. Shipments west of Mississippi River take additional freight charge.

Quarts and gallons are shipped by parcel post or express only. Returned drums are accepted only when consigned to us at Hackensack, New Jersey, freight or express prepaid.

WE GUARANTEE that, if you will divide an orchard, your worst or best, in two parts equal in general condition, and for three years spray one part with SCALECIDE according to our directions and the other part with lime-sulfur, giving the same summer treatment to both parts, the part sprayed with SCALECIDE will be better than the part sprayed with lime-sulphur—in the judgment of three disinterested fruit growers—or we will refund the money you have paid for the SCALECIDE.

Average amount of dilute SCALECIDE needed.

2 to 5-year-old trees.....	1/8 to 1/4 gal.
6 to 8 " " "	3/4 to 1 "
9 to 13 " " "	1 to 1 3/4 "
14 to 18 " " "	2 to 2 1/2 "
19 to 24 " " "	3 to 3 1/2 "
25 to 30 " " "	3 1/2 to 4 "

Figure one gallon SCALECIDE to spray as many trees as three and one half gallons lime-sulfur.



The Net Result

